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THE EXPANSION OF TECHNOLOGICAL POSSIBILITIES OF VERTICAL HYDRAU--ETC(U)
MAY 79 F V TULYANKIN , L Y MEDVEDEV

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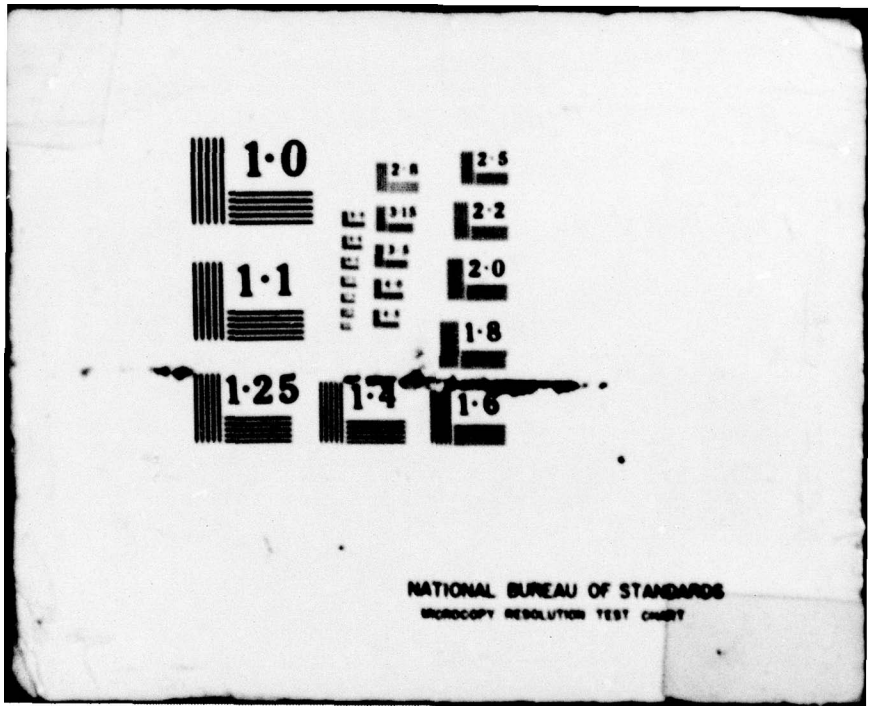
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THE EXPANSION OF TECHNOLOGICAL POSSIBILITIES OF VERTICAL HYDRAULIC STAMPING PRESSES

By

F. V. Tulyankin, L. Ye. Medvedev, et al

EDITED TRANSLATION

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К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

THE EXPANSION OF TECHNOLOGICAL POSSIBILITIES OF VERTICAL HYDRAULIC STAMPING PRESSES

F.V. Tulyankin, L.Ye. Medvedev, V.A. Novoselov, V.S. Ogurtsov

A press attachment is mounted on a stamping press with a force of 10,000 tons, which permits obtaining hollow precise stampings (with internal cavities) of good quality and weight reduced by 15%-30%.

The technology of production of such stampings from steel and aluminum alloys has been developed.

Modern vertical hydraulic stamping presses with a force of up to 75,000 tons are used in the manufacture of a large products list of stampings from light, heat-resistant, titanium alloys and also alloyed steels. Developed on these presses is the stamping of large-scale aircraft assemblies without the machining of one ribbing surface with an area of up to 2.7 m^2, struts, girders, complex frames, disks of gas turbines 1200 mm in diameter, and others.

With respect to the diversity of geometric shape, dimensions and precision, the stampings obtained on hydraulic presses exceed the stampings obtained on the air-steam hammers. However, the massive parts having internal cavities of the type of propeller hubs of helicopters and aircraft, and complex assemblies of aircraft landing gears and wheels both on hammers and presses up to now were stamped in dies with one horizontal parting line.

Here the internal cavities remain filled with metal; such stampings differ little in the coefficient of the use of the metal and the laboriousness of the machining from forgings manufactured by smith forging.

During the 1960's, in the USA and West Germany, there began to be used stamping presses of 11,000, 18,000 and 30,000 tons, and these were equipped with horizontal and vertical punching systems.

On such presses it is possible to stamp articles by three methods: vertical, horizontal and combined.

For the production of volumetric hollow stampings and the study of the industrial parameters according to the technical assignment of VILS [acronym unknown] by VNIIMETMASh [All-Union Scientific Research, Planning and Design Institute of Metallurgical Machinery] and the Novo-Kramatorsk plant of heavy machine building, developed and manufactured was a press-attachment with two side plungers with a force of 1500 tons each, immobilely attached to the mobile cross beam of the press.* The press-attachment was designed specially for the vertical hydraulic press with a force of 10,000 tons (Fig. 1).

The structure of the attachment is calculated for the stamping of parts with internal cavities and side projections.

The overall dimensions of the press-attachment (without the industrial feeds) are: length - 9200 mm, width - 1825 mm, height - 2050 mm. It weighs 120 tons. The feed is produced from a pump-accumulator station and filling system of the press.

Figure 2 gives a schematic representation of the press-attachment in a longitudinal cross section.

Being laid into the lower half of the die, the billet of cylindrical, rectangular or more complex shape, equal in weight to the obtainable stamping, taking into account the compensation of the loss (for steel and titanium), with movement of the main

*Tulyankin, F.V. and others. Bulletin Izobreteniya, prom. obraztsy, tov. znaki [Inventions, industrial models, trade marks], 1969, No. 10.

cross piece downward, is subjected to upsetting up to coupling of the dies along the line of the horizontal parting plane. The cavity of the die is preliminarily filled with the metal. Upon the reaching of the total calculated pressure, in the operating vertical cylinders of the press there is produced a pressure into the side horizontal cylinders of the press-attachment, and a deep two-sided or one-sided punching of the side cavities of the die is carried out with the final filling of all the cavities of the die.

Fig. 1. External view of a press with a force of 10,000 tons after the installation of the press-attachment.

Then, not removing the forces acting on the vertical cross piece, a reverse stroke of the horizontal forging punches is carried out. Upon completion of the stroke, the attachment is raised, and the forging is ejected from the lower die. Removal of the forging can be done both without the advancement of the table and after advancement of the table by means of the lower ejector of the press. With the raised cross piece, since the upper half of the die and the side cylinders are fastened on it, the movement of table with the lower half of the die is accomplished without noise. In the designing of dies and the development of the technology of stamping on a press-attachment, besides the usual requirements, the principle of the non-openability of the dies in the process of side piercing should be fulfilled. At equal

diameters of the horizontal forging punches, to do this it is necessary that

$$P_в > P_г \cdot$$

where $P_в$ is the force being developed by the vertical cylinders of the press; $P_г$ - the force being developed by the horizontal plunger of the press-attachment; $F_ш$ - the area of projection of the stamping onto a horizontal plane; $F_{пр}$ - the area of the cross section of the horizontal forging punch.

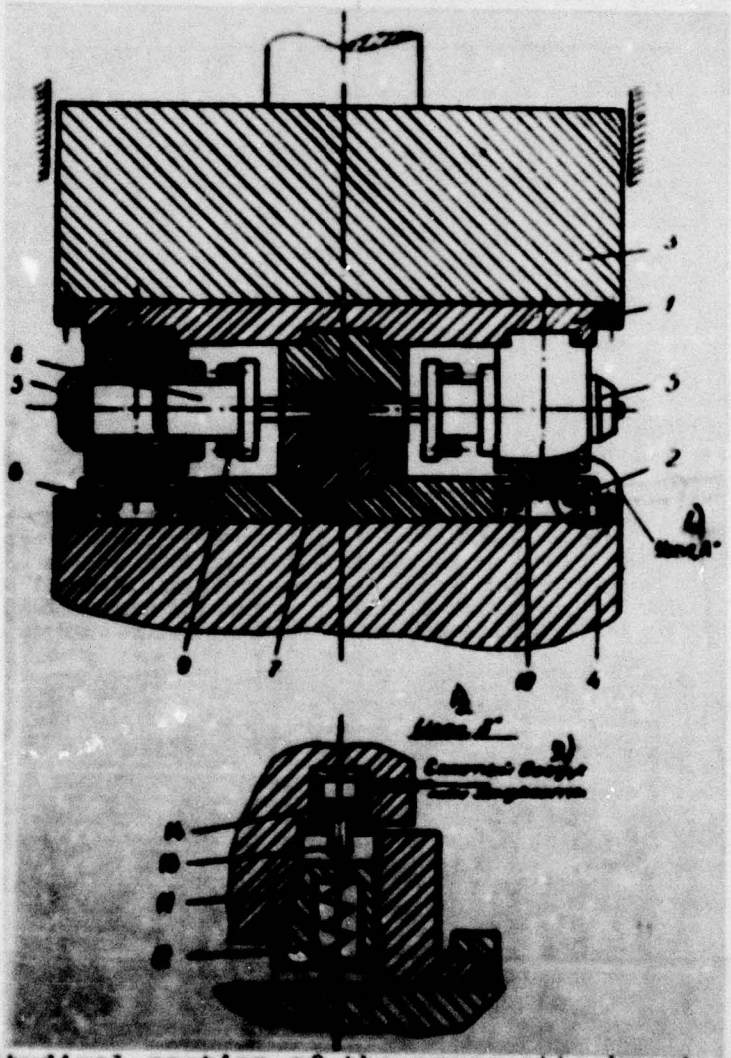

Fig. 2. Longitudinal section of the press-attachment and assembly of the wedge attachment of the side cylinders: 1 - upper sub-stamping plate; 3 - slider block; 4 - press table; 5 - two

[Fig. 2 cont'd.] horizontal cylinders; 6 - attachments for the restraining of the projections of the cylinders; 7 - lower and upper halves of the die; 8 - plungers; 9 - rods; 10 - projections of the cylinders; 11 - wedges; 12 - contracted plungers; 13 - stops; 14 - hydraulic cylinders. KEY: 1) Assembly "A"; 2) Compressed air or liquid.

The stroke of the horizontal forging punches is limited by the stop rings attached to the horizontal plungers and resting in the ends of the die at the end of the forging punch.

Conducted at VILS [acronym unknown] was the work on the searching and selection of a list of specific hollow parts the technology of the manufacture of which could be worked out on the press-attachment. Selected as a result were the characteristic parts for which the drawings of stampings and dies are developed, including the following:

1) the housing of a propeller hub (Fig. 3) is a standard part manufactured in large quantities; the forged billet of the housing is a solid of revolution with four cylindrical branches in which there is provided the obtaining of two pairs of cavities of different depth; deep cavities are formed with the introduction of the side forging punches into the body of the billet, and small cavities are formed as a result of the installing of dumming forging punchers in the die;

2) the journal of the axle joint is one of the aggregate parts of complex shape; as is evident from Fig. 4, the forged billet has side marks in the head part, two lugs and a cylindrical branch pierced over the entire length.

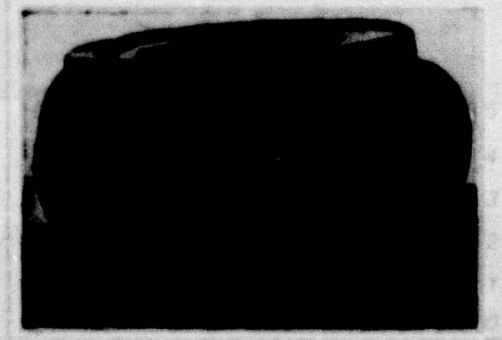

Fig. 3. Forged billet of the housing of a propeller hub of steel 12Kh2N4A

Fig. 4. Forged billet of a journal of an axle joint of alloy D1.

The billet of the housing of the propeller hub was forged during one transition. With the closing of the dies, there occurred the mounting of the billet without the inflowing of the metal into the parting line and the partial distribution of the metal over the volume of the cavity of the die. The final forming occurs with the introduction of the side punches into the body of the billet. Locks are provided in the design for eliminating the shift in halves of the die with respec to each other.

The billets were heated to 1150°C. The temperature of the surface of the forgings were monitored by an optical pyrometer: the temperature of the beginning of the forging was 1130-1080°C; at the end of the forging, 1100-1000°C; and the temperature of the dies was 300°C.

The oil vapor T and graphite were used as lubricants.

According to the given technology, a batch of forgings in the quantity of 8 pieces was obtained.

Forged billets of the journal of the axle joint were obtained according to two industrial variants in the same set of die in the same set of dies.

According to the first variant, the forged billets were obtained in two operations: preliminary stamping (peening) and final stamping. During the preliminary stamping there occurs the forming of the head part, and during the final stamping (after heating)

there occurs a punching of a hole in the branch.

According to the second variant, the forged billets were obtained with the combination of the operation of the peening and piercing from one heating. The peening was produced by a piercing punch through a special insert, after the removal of which the billet was pierced.

The billets were stamped from steel 40KhNMA (which corresponded to the material of the full-scale part) and aluminum alloy D1. After a number of experiments, the full forming of the stamped billets from alloy D1 was achieved. Observed on the forged billets of steel is the partial non-forming of lugs (at 10-20 mm) and bosses (3-6 mm) located in the head part of the journal.

To study the nature of the flow of the metal and the distribution of deformations in different volumes of the body on blanks for the stamping of the body of a screw from alloy AV, a coordinate grid was applied (onto the external surface and in the axial plane). In the stamping the blanks with the coordinate grid were set so that the plane of cross section was perpendicular to the direction of movement of the plungers.

On billets of a jounal of an axial joint, the coordinate grid was applied only on the external surface (see Fig. 4).

The necessary force of the clamp was determined by the recording of the moment of opening of the dies in the stamping process. To do this, along the parting line of the dies near the openings for the entry of the side punches and the dummy punches there were glued sensors, which recorded the compressive stresses in the die. It was assumed that the opening of the dies came at the moment of the zero stresses at places of the setting of the sensors.

Since the set sensors could operate at a temperature of not more than 50-60°C, the studies were conducted with the deforming of the billets from alloys AV and D1 heated to 460°C in unheated dies, the temperature of which was 20-25°C.

The clamping of the dies was carried out successively by three, two and one cylinders of the press, which corresponded to forces of 9000, 6000 and 3000 tons.

It has been experimentally established that the guaranteed clamping, which completely eliminates the inflowing of metal into the parting line of the dies, was provided under a force of 9000 tons. In clamping with a force of 6000 tons, although a complete opening of the dies was not observed, but due to their deformation there occurred a local opening along the perimeter of the shape of the die, which is confirmed by the presence on the dies of a thin flash with a thickness of 1.0-1.6 mm. The dies were completely opened with clamping with a force of 3000 tons.

The forging was ceased with the visual recording of the moment of opening of the dies.

To reveal the actual rate and hydrodynamic characteristics, with operation of a press with a press-attachment the following parameters were recorded:

cycle graphs of the change in pressures in operating cylinders of the press (central and side) and operating cylinders of the press-attachment;

cycle graphs of movements of the cross-piece and plungers of the press-attachment.

The movements were measured by means of string hodographs and time sensor, and the pressure - by hydraulic capsules. Signals from the time hodographs and hydraulic capsules were measured by the oscillograph N-700 with the amplifier UTS-121.

In a number of experiments the recording of stresses in base parts of the press-attachment were carried out. Measurements were conducted in conformity with the method developed jointly with VNIIMETMASh.

Preliminary data of the experimental determination of the rates are: the rate of movement of the plungers of the press-attachment with the approach stroke varied from 25 to 50 mm/s; with the operating stroke - from 30 mm/s to zero; with the return stroke - from 50 to 120 mm/s.

The obtained results make it possible to draw the conclusion about the need and expediency of the creation of multiplunger presses with horizontal and vertical punching systems.

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